

Reciprocal predation involving Odonata, Asilidae and Saltatoria

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Key words: Odonata, dragonfly, Asilidae, Diptera, Ensifera, Caelifera, Saltatoria, reciprocal predation, Europe.

ABSTRACT

A singular observation of an adult *Tettigonia viridissima* (Tettigoniidae) that captured a female *Eutolmus rufibarbis* (Asilidae) sucking a male *Lestes sponsa* (Lestidae) is reported. The reciprocal predation of Odonata, Asilidae, and Saltatoria (Ensifera, Caelifera) hitherto recorded in Europe is compiled and augmented by unpublished data on asilids as predators of odonates. Heavy predation by robberflies may occur only on grasshoppers and dragonflies; all other reciprocal predation events are occasional.

INTRODUCTION

Occasional or even heavy predation on dragonflies (Odonata) by robberflies (Diptera: Asilidae) has long been known and described by several authors (e.g. McLachlan 1873; Adamović 1963b; Stoks & De Bruyn 1996). On the other hand, there are few accounts on robberflies as prey of dragonflies (Adamović 1963a, 1964) and few or no reports have been available on the interrelation between dragonflies and grasshoppers (Ensifera, Caelifera). By way of contrast, there are numerous records of grasshoppers as prey of robberflies (Adamović 1968) but no robberflies have been reported to be preyed upon by grasshoppers. In this communication the nutritional interrelations between the taxa hitherto published in Europe are compiled and augmented by unpublished data on asilids as predators of odonates, stimulated by a singular incidental observation that documents a one-way predator-prey-relation between all three groups simultaneously.

LOCALITY AND METHODS

The encounter with a bush cricket that captured a robberfly preying upon a zygopteran took place in a small mire that is part of the 'Drumlinlandschaft Zürcher Oberland', a nature reserve near Wetzikon, ca 20 km ESE of Zurich, Switzerland (47°19'N, 08°48'E). Additional data on predation on Odonata by members of

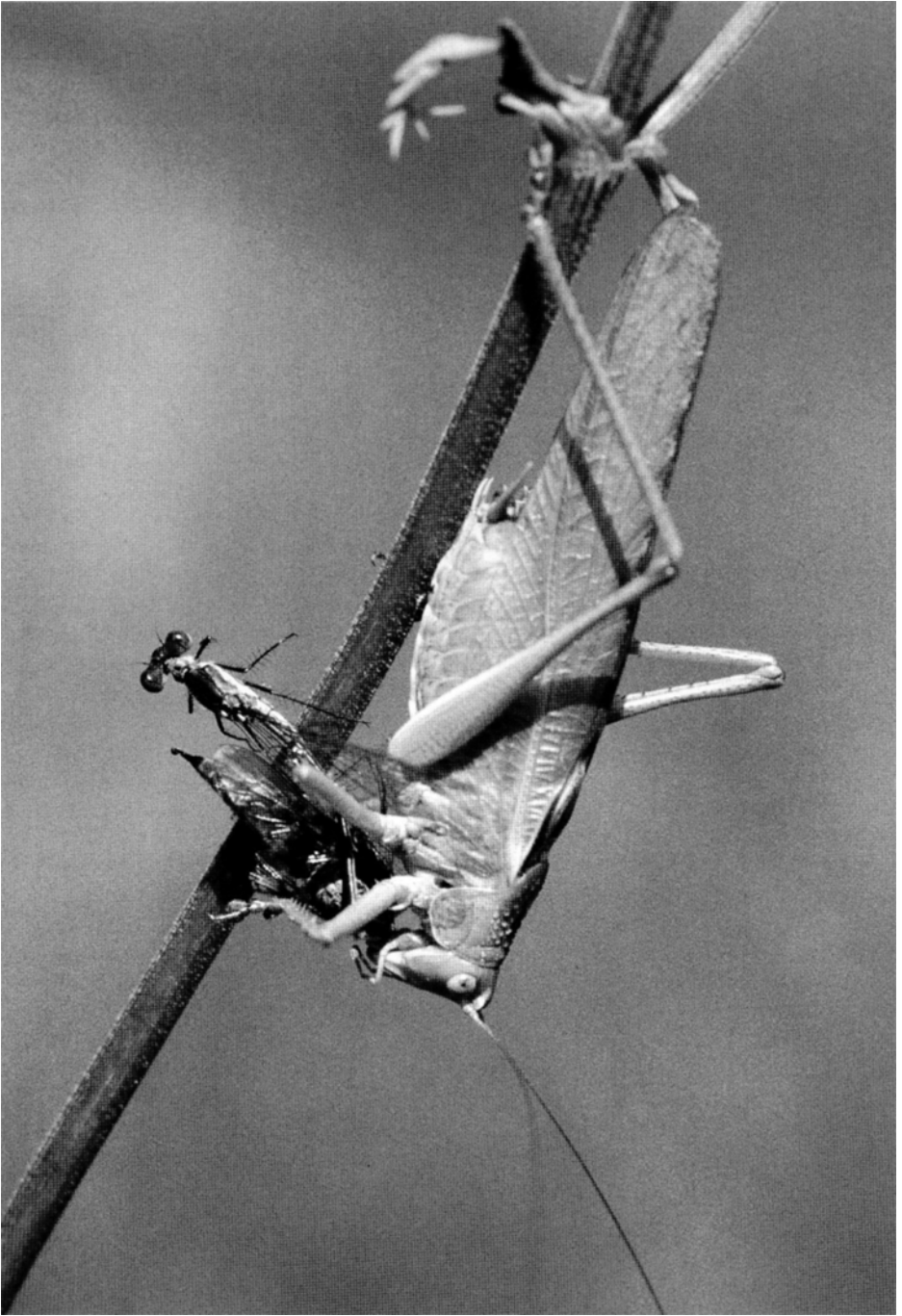


Figure 1: Bush cricket (*Tettigonia viridissima*) devouring a robberfly (*Eutolmus rufibarbis*) that was previously exsanguinating *Lestes sponsa*. Wetzikon, Switzerland, 27 July 2005. Photo by Hansruedi Wildermuth.

Asilidae were collected from a number of odonatologists in Europe who made their unpublished observations available for this compilation. Furthermore, the European literature was searched for documents on nutritional interrelations between Odonata, Asilidae and Saltatoria (Ensifera, Caelifera). The concentration on the Westpalaeartic region seemed justified as all three taxa are relatively well known in Europe. Moreover, the data on the subject available from different parts of the world are rather heterogeneous and therefore imperfectly comparable. The literature search focussed on the number of species of each taxon concerned in nutritional interrelation as well as on the number of recorded predation events. It is assumed that most but certainly not all published records were found.

RESULTS

On 27 July 2005 at 10:05 h solar time, while approaching a small circular pond, I disturbed an asilid from vegetation at the water's edge. The fly was sucking a zygopteran and flew across the pond, still grasping its prey, and landed on a tall herb (*Angelica sylvestris*) ca 80 cm above the ground. Immediately after the asilid landed a bush cricket that was perched on the plant seized the robberfly by a quick short leap and instantly started to devour it (Fig. 1). After taking a photograph I took the asilid from its predator in order to save it for later identification. Although the bush cricket had already excavated the head of its victim the important part of the capsule needed for determination was still preserved. All three individuals that were involved in the brief incident were identified with respect to species, sex and age: they comprised *Lestes sponsa* (Hanseemann) (Lestidae), adult male, *Eutolmus rufibarbis* (Asilidae), adult female, and *Tettigonia viridissima* (Tettigoniidae), adult male.



Figure 2: A male *Erythromma lindenii* as prey of *Philonicus* cf. *albiceps*. Nestos Delta, Greece, 18 July 1992. Photo by Frank Hecker.

Table 1. Hitherto unpublished records of Odonata as prey of Asilidae in Europe. — CH: Switzerland, D: Germany, E: Spain, F: France, GR: Greece, I: Italy, PL: Poland.

Prey	Locality	Date	Source/reference	Document
<i>Calopteryx splendens amasina</i> Bartenev ¹	Nestos Delta (GR)	01 vii 1992	F. Hecker	Fig. 4
<i>Lestes macrostigma</i> (Eversmann)	Evros Delta (GR)	19 vi 2003	E. Baierl	Pers. comm.
<i>Lestes sponsa</i> (Hansemann) ²	Wetzikon (CH)	27 vii 2005	H. Wildermuth	Fig. 1
<i>Lestes virens</i> (Charpentier)	Castel Porziano (I)	vi 1994	A. Cordero	Photo
<i>Lestes viridis</i> (Vander Linden)	Manosque (F)	09 vii 1994	M. Lohr	Photo
	Rheinhausen (D)	25 vi 2003	E. Westermann	Pers. comm.
<i>Sympetma fusca</i> (Vander Linden) ³	Bielice (PL)	23 viii 2003	J. Samoląg	Pers. comm.
<i>Ceriagrion tenellum</i> (de Villers)	Centeáns (E)	31 vii 2003	A. Cordero	Photo
<i>Coenagrion mercuriale</i> (Charpentier)	Manosque (F)	19 vi 1994	M. Lohr	Photo
<i>Coenagrion puella</i> (Linnaeus)	Manosque (F)	11 vii 1994	M. Lohr	Photo
	Nestos-Delta (GR) ^{3, 8}	10 v 1992	F. Hecker	Photo
<i>Enallagma cyathigerum</i> (Charpentier)	Gronau (D)	11 vii 1999, 14 vii 2004	E. & W. Postler	Pers. comm.
	Dülmen (D)	11 viii 2001	E. & W. Postler	Pers. comm.
	Amrum (D) ^{3, 8}	14 viii 1997	E.G. Schmidt	Photo
	Haltern (D) ^{2, 8}	01 ix 2005	E.G. Schmidt	Photo
<i>Erythromma lindenii</i> (Selys) ^{3, 8}	Nestos Delta (GR)	18 vii 1992	F. Hecker	Fig. 2
<i>Ischnura elegans</i> (Vander Linden)	Gościm (PL)	30 vi 1997	R. Bernard	Pers. comm.
	Lagoa Louro (E)	20 vii 1996	A. Cordero	Photo
	Bonn (D) ⁵	28 vii 1985	E.G. Schmidt	Photo
<i>Ischnura graellsii</i> (Rambur)	O Rosal (E)	viii 1990	A. Cordero	Photo
<i>Platycnemis pennipes</i> (Pallas)	Kenzingen (D)	28 vii 2005	K. Westermann	Pers. comm.
	Nestos Delta (GR) ^{3, 8}	28 vi 1992	F. Hecker	Plate IIIa
<i>Onychogomphus forcipatus albotibialis</i> Schmidt	River Lautani, Rhodos (GR)	24 vi 2005	R. Horn	Pers. comm.
<i>Crocothemis erythraea</i> (Brullé) ^{5, 8}	Camargue (F)	31 vii 2003	E. Miller	Plate IIIb
<i>Orthetrum chrysostigma</i> (Burmeister)	River Lautani, Rhodos (GR)	01 vii 2005	R. Horn	Photo
<i>Sympetrum pedemontanum</i> (Müller in Allioni)	Rheinhausen (D)	27 vi 2003, 07 vii 2003	E. Westermann	Pers. comm.
<i>Sympetrum sanguineum</i> (Müller)	Zehdenick (D)	14 viii 1995	E. Baierl	Pers. comm.

Prey	Locality	Date	Source/reference	Document
<i>Sympetrum striolatum</i> (Charpentier)				
	Oderberg (D)	16 viii 1995	E. Baierl	Pers. comm.
	Rheinhausen (D)	25 vii 2004	E. Westermann	Pers. comm.
	Nestos Delta (GR) ⁶	19 vi 1993	F. Hecker	Fig. 5
<i>Trithemis annulata</i> (Palisot de Beauvois) ⁷				
	River Lautani, Rhodos (GR)	21 vi - 04 vii 2005	R. Horn	Pers. comm.
<i>Trithemis festiva</i> (Rambur) ⁷				
	River Lautani, Rhodos (GR)	21 vi - 04 vii 2005	R. Horn	Pers. comm.

¹ Prey of *Eutolmus* Loew, 1848

² Prey of *Eutolmus rufibarbis* (Meigen, 1820)

³ Prey of *Philonicus* cf. *albiceps* (Meigen, 1820)

⁴ Prey of *Neoitamus* Osten Sacken, 1878

⁵ Prey of *Stenopogon* Loew, 1847

⁶ Prey of unidentified Asilinae

⁷ Repeatedly failed attacks

⁸ Identified according to photos – only specimens allow an exact identification

The results of enquiries with odonatologists are summarized in Table 1. In total 29 records with 20 odonate species were received, 13 of which were photographically documented (e.g. Figs 2, 4, 5, Plate III). Asilid species were identified with certainty in two cases only. All records concerned single events and no repeated or regular predation of Odonata by Asilidae was observed.

The analyzed publications varied greatly in respect to their informational content on nutritional interrelations between Odonata, Asilidae, and Saltatoria. In most cases only incidental observations are reported. Quantitative data, i.e. numbers of predation events are available from very few publications and then merely on asilids as predators of odonates and grasshoppers. The number of recorded species involved as predators and prey, as well as the number of observed predation events are compiled in Figure 3. By far most records of predation acts concern asilids that attacked Saltatoria (mostly Caelifera) and Odonata. Conversely, Asilidae as prey of Odonata or Saltatoria – only Ensifera are at least to some extent carnivorous – have very rarely been detected. *Tettigonia viridissima* eating *Eutolmus rufibarbis*, as described here, obviously represents a singular event of Ensifera preying on Asilidae. Likewise, recorded reciprocal predation between Odonata and Saltatoria is exceptional.

DISCUSSION

Attacks on *Lestes sponsa* by the robberfly *Eutolmus rufibarbis* are reported by Stoks & De Bruyn (1996). They witnessed 16 acts of predation by this asilid on *L. sponsa*, demonstrating that *E. rufibarbis* may regularly feed on this lestid at localities where both insects are common. *E. rufibarbis* is not monophagous: it also preys on *Enallagma cyathigerum*, as shown in the same study, and on other insect taxa (Esipenko 1967). However, in the latter case, the proportion of zygopterans species taken as prey remains unknown.

Asilids are catholic predators that attack members of various insect orders. According to a study in France (Musso 1978) the main prey items are Hymenoptera (40%), Diptera (29%), Coleoptera (12%), and Lepidoptera (9%). Furthermore, Heteroptera, Homoptera, Saltatoria, and Odonata may also contribute substantially to the diet of asilids (Adamović 1963b). Depending on the habitat type and the asilid species the nutritional value of the different taxa may vary greatly. Adamović (1968) found that in *Stenopogon mediterraneus* 67.3% of prey items consisted of Saltatoria whereas in *Machimus annulipes* this value was only 2.7%. During Adamović's study in the eastern part of former Yugoslavia odonates were preyed upon by two out of 10 asilid species and the former amounted to less than 10% of all prey items. Repeated predatory acts by certain asilid species on dragonflies are only reported by Adamović (1963b), Moss (1992) and Stoks & De Bruyn (1996). Otherwise in most cases only single predatory acts are observed. Even during his intensive field study on *Ischnura graellsii* Cordero (1992) saw only two successful attacks of an asilid on this zygopteran.

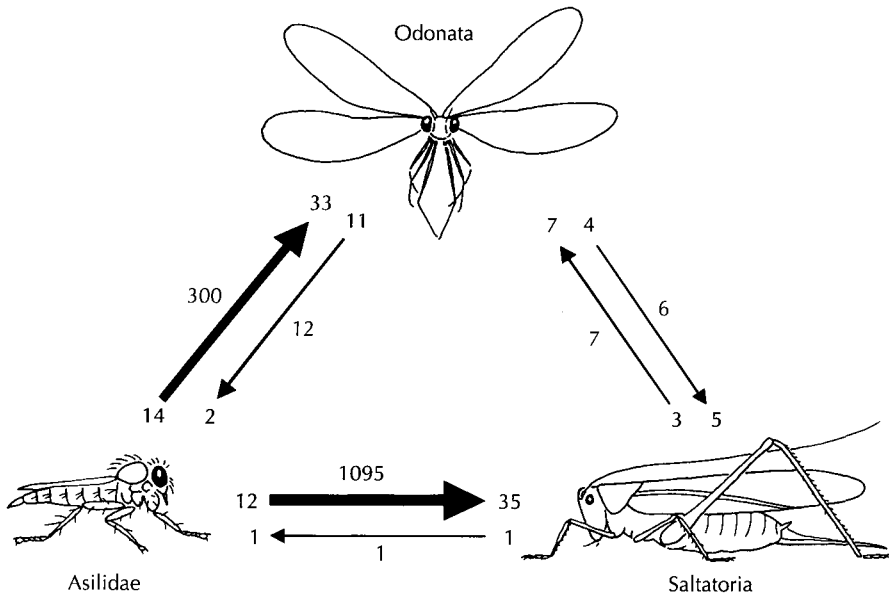


Figure 3: Reciprocal predation of Odonata, Asilidae, and Saltatoria in Europe. — Direction of interrelation and its importance are indicated by arrows. Figures at head of arrows: number of recorded prey species, at end of arrows: number of recorded predator species, in middle: recorded number of events. The numbers are based on the data in Table 1 and on those from Adamović (1956, 1963a, 1963b, 1964, 1968), Bainbrigge Fletcher (1936), Bos et al. (2002), Clements (1999), d'Aguilar & Dommanget (1998), Ergashev (1970), Gardner (1949), Goodyear (1969), Greathead (1963), Hecker (1994), Hobby (1932), Jakob & Suhling (1999), Kunz & Wildermuth (2006), Lavigne (1976), Melin (1923), Monnerat (1993), Morton (1932), Parmenter (1941, 1952), Pinchen et al. (1998), Poulton (1906), Rehfeldt (1995: 89), Schmidt (1954), Sternberg (1999), Stoks & De Bruyn (1996), Truscott (1999), van Veen (1996), Yarrow (1937).

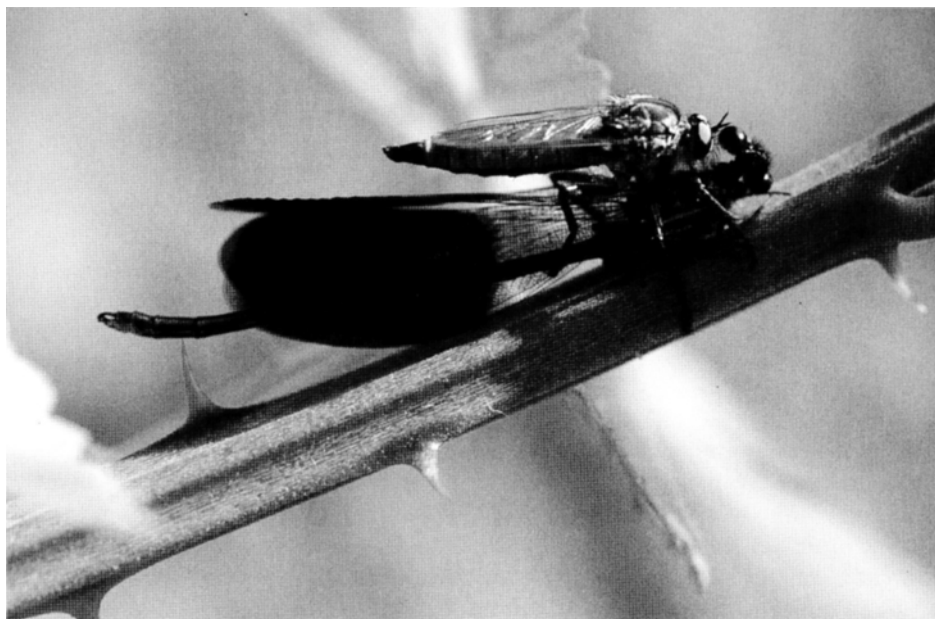


Figure 4: *Eutolmus* sp. overwhelmed a male *Calopteryx splendens amasina*. Nestos Delta, Greece, 01 July 1992. Photo by Frank Hecker.



Figure 5: A teneral male of *Sympetrum striolatum* as a victim of an asilid. Nestos Delta, Greece, 19 June 1993. Photo by Frank Hecker.

Robberflies may successfully attack large odonates, their proboscis often being inserted dorsally into the thorax between the wing bases, as impressively documented by Shimizu (1992: 61). According to published records *Satanas gigas* was seen to prey on *Aeshna grandis* (Linnaeus) (Federov 1925), *Stenopogon inquinatus* on *Aeshna umbrosa* Walker (Platt & Harrison 1995), *Trichomachimus paludicola* on *Caliaeschna microstigma* (Schneider) (Lehr 1967), and *Dysmachus trigonus* on *Oxygastra curtisii* (Dale) (Morton 1932). However, asilids usually capture smaller anisopterans such as *Sympetrum* spp. or zygopterans.

The successful attack on a robberfly by a bush cricket reported here completes the possible sixfold nutritional interrelation between Odonata, Asilidae, and Saltatoria (Fig. 1). Although the compilation of recorded acts of predation is certainly incomplete, it clearly shows that Asilidae constitute the main predators in the nutritional triangle. Attacks on asilids by anisopterans – zygopterans have not been recorded attacking robberflies so far – may occur more frequently. Yet the latter are opportunistic foragers that feed predominantly on small dipterans caught in midair or rarely by gleaning (Corbet 1999: 343-350). Asilids are agile and strong fliers and usually forage from a perch. While waiting for prey they keep motionless and therefore are hardly detected by odonates. Carnivorous Saltatoria (Ensifera) may catch an asilid on its perch, especially when the latter is handling a prey item. In any case such events are only witnessed occasionally.

ACKNOWLEDGEMENTS

I thank Gerhard Bächli for the identification of *Eutolmus rufibarbis* and Fritz Geller-Grimm for his effort to identify some asilids on photographs and for his help in search of literature. Andreas Müller kindly made some publications available that were difficult to obtain. Thanks are due to Philip Corbet and Andreas Martens for their suggestions as well as to Frank Hecker and Elfi Miller for providing their photographs and to all odonatologists listed in Table 1 who made their unpublished observations available.

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